Extending In-Situ Dating to New Geochronometers: Pb-Pb, Sm-Nd, Re-Os, and LuHf

Completed Technology Project (2017 - 2020)

Project Introduction

Goals This proposed work will extend laser ablation resonance ionization spectrometry (LARIMS) from the previously demonstrated rubidium-strontium (Rb-Sr) geochronology system to four other radiogenic systems, enabling in-situ, concordant age determinations to be made on extraterrestrial bodies in the solar system. This capability addresses a critical need to provide dating information to fulfill NASA's goal of understanding the history of the solar system. Advantages include providing an independent test of concordance, while expanding the potential range of samples that can be successfully measured. Testing for concordance is important because individual isotopic dating systems can be biased by a variety of factors. These biases are frequently distinct for different radiometric systems. In addition to extending LARIMS to additional geochronology systems, an existing backup laser system will be advanced from TRL 2 to TRL 3. Objectives This proposal addresses the important NASA goal to understand the history and evolution of the solar system. The time of key events in solar system history are poorly constrained by current samples, giving impetus to future missions with sample return and in-situ (landed) dating measurements. An issue for in-situ radiometric measurements is the desire for testing concordance, i.e. the ability to validate the measured age of a sample by using multiple dating systems. We have demonstrated LARIMS by dating several samples using the Rb-Sr method and we have completed preliminary work that demonstrates the technique can be extended to Pb-Pb geochronology. The objective of this proposal is to perform measurements that enable us to assess LARIMS capabilities with other geochronology systems and to determine and overcome obstacles to developing in-situ measurements based on these systems in future missions. This work, in combination with our successful (Rb-Sr) dating program, our recent lead-lead (Pb-Pb) dating study, and our preliminary samarium-neodymium (Sm-Nd) spectroscopy measurements, will complete a systematic study to assess the potential range of radiometric dating approaches for LARIMS analyses using a suite of geochronology dating systems, including Rb-Sr, Pb-Pb, Sm-Nd, rhenium-osmium (Re-Os), and Lutetium-Hafnium (Lu-Hf).

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

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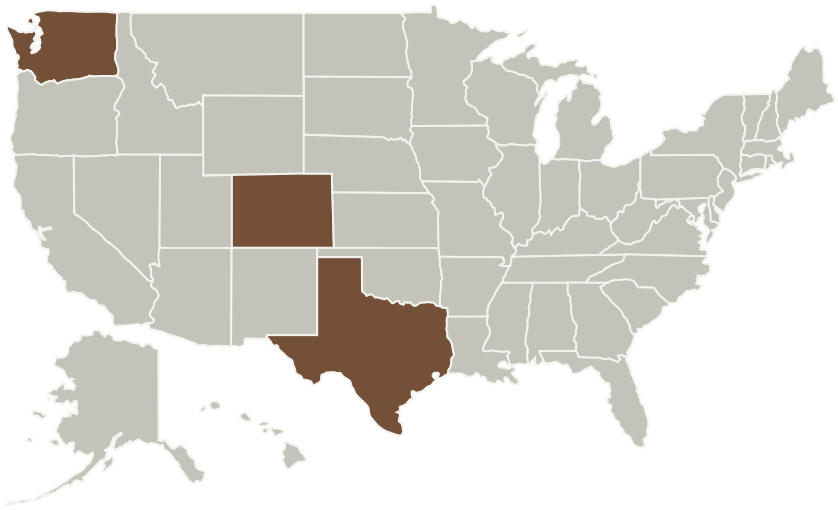
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Southwest Research Institute - San Antonio(SWRI)	Supporting Organization	Academia	San Antonio, Texas

Primary U.S. Work Locations	
Colorado	Texas
Washington	

Project Management

Program Director:
Carolyn R Mercer

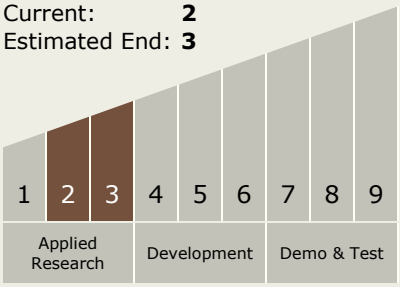
Program Manager:
Haris Riris

Principal Investigator:
Fletcher S Anderson

Co-Investigators:
Tom J Whitaker
Jeffrey W Pierce
Ronald B Kalmbach

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.3 Sample Handling

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Target Destination

Others Inside the Solar System